

1.0 Project Description

1.1 Project Background

On September 30, 2002, the City of Baltimore entered into a Consent Decree (CD) with the United States Environmental Protection Agency (EPA), the State of Maryland Department of the Environment (MDE). The objective of Paragraph 9 of the CD was to complete a series of "Collection System Evaluation and Sewershed Plans". This Sewershed Study and Plan details the evaluation of the Low Level Sewershed, one of eight Baltimore City Sewersheds

The Low Level Sewershed Study and Plan, Project No. 1029, generally consists of inspection and characterization of the sewage collection system in the Low Level Sewershed. Project No. 1029 consists of a wide range of activities as defined by the CD. These include flow monitoring; collection of rainfall data; manhole inspection; closed circuit television (CCTV) video inspection; smoke testing; dyed-water testing; updates to the City's GIS based sewer mapping system; analysis of complaint data; projections of current and future base sanitary flow (dry weather); preparation, calibration and validation of a hydraulic model; identification of critical sewer system components; condition assessment and criticality rating; formulation of a long term rehabilitation and corrective action plan; preparation of cost estimates and preparation of the sewershed plan. The City of Baltimore contracted with Hazen and Sawyer, P.C., Patton Harris Rust & Associates, and Hatch Mott MacDonald, LLC to complete this work in May 2007.

The study area for the Low Level Sewershed includes approximately 1,392,100 linear feet (LF) of gravity sewer ranging in size from 6- to 84-inches in diameter; approximately 8,600 manholes, junction chambers and siphon chambers; 39,000 LF of force main and pressure sewer; 6 sewer siphons; two primary Interceptors (East and West); and three major pumping stations, the Eastern Avenue Pumping Station (120 mgd capacity), the Locust Point Pumping Station (1.8 mgd capacity) and the McComas Street Pumping Station (0.7 mgd capacity).

The sewershed study and plan elements are defined in the CD Paragraph 9.C as summarized below:

- i. An evaluation of the effectiveness of completed and proposed projects using rainfall and flow monitoring data and the hydraulic model
- ii. Identification of deficiencies discovered during inspections
- iii. Identification of rehabilitation and other corrective actions taken to address deficiencies
- iv. Identification of rehabilitation and other corrective actions proposed to be taken
- v. Description of decision making criteria for selection of future corrective action
- vi. Plan and schedule for implementation of rehabilitation and other corrective action found necessary to correct deficiencies
- vii. Preparation of a prioritization scheme applied to rehabilitation projects
- viii. Preparation of cost estimate for proposed rehabilitation and other corrective action
- ix. Preparation of a plan and schedule for eliminating physical connections between sanitary sewer and storm drains
- x. Determination of a range of storm events for which existing collection system can convey peak flows without occurrence of sanitary sewer overflows (SSOs)

- xi. Identification of model components that have the potential to cause or contribute to overflows
- xii. Determination of the range of storm events for which peak flows can be conveyed without occurrence of SSOs once the recommended construction projects are in place
- xiii. Presentation of the results of rainfall and flow monitoring conducted in the sewershed
- xiv. Description of the quality assurance and quality control analyses performed for data collected
- xv. Description of the smoke and dye testing performed
- xvi. Quantification of inflow and infiltration (I/I) and identification of sources of the I/I
- xvii. Description of additional data collection activities that will continue after completion of rehabilitation and corrective action
- xviii. Certification that the GIS system is functional in accordance with Paragraph 14.B of the CD

The content and structure of this Sewershed Study Report have been established to address each of the sewershed study and plan elements required under the CD.

1.2 Sewershed History/Previous Studies

Prior to 1912, all piped sewage in the City of Baltimore was discharged directly to the harbor, causing unpleasant odors and unsanitary conditions throughout the City, especially in the harbor area. To address this situation, the City built a large treatment facility at a site on the Back River, east of the City. Sewage outlets were diverted from the storm drains and connected to lines leading to the Back River. The Back River Wastewater Treatment Plant (WWTP) started treating sewage in 1912 with an initial capacity of 12 million gallons per day (mgd). The Eastern Avenue Pumping Station was also constructed in 1912 to convey flows from low-lying areas that could not drain to the Back River WWTP by gravity. The pumping station initially contained three large steam-driven pumps that were replaced by five low-profile electric pumps and one diesel pump between 1959 and 1961. In the 1980's, major structural and architectural renovations, improvements to the ventilation system, and other upgrades needed to handle the needs of the growing City were completed. The station currently contains six pumps. Five are connected to the force main system, which discharges to the Outfall Sewershed. The sixth pump is for emergency relief. This latter pump is diesel powered and discharges directly to the harbor. Although discharges historically occurred approximately three times a year and were usually the result of equipment malfunctions, a direct discharge to the harbor has not occurred in many years. The Eastern Avenue Pumping Station is listed by the National Parks Service on the National Register of Historic Places. Baltimore City also maintains a Public Works Museum at the site, which opened in 1982.

Over the years, several studies have been performed within the City by multiple engineering consultants. These include system-wide studies dating back to the 1975, to more recent studies and hydraulic evaluation projects of specific sections of the collection system. These studies, where available, were reviewed and considered in the preparation of this plan.

The 1975 "Back River Wastewater Treatment Plant Infiltration/Inflow Analysis of Wastewater Collection System" prepared for the City of Baltimore evaluated the extraneous flow entering the collection system tributary to the Back River wastewater treatment plant. A sewer system evaluation survey to locate extraneous flow sources was not recommended for the Low Level

Sewershed at that time. The maximum infiltration rate at the Eastern Avenue Pumping Station was reported as 7.16 MGD and a maximum expected inflow rate of 60.5 MGD was reported for the Low Level Sewershed.

The 1992 “City of Baltimore Facility Plan for the Back River Conveyance System,” was prepared in response to requirements of the Federal Water Pollution Control Act of 1972, which requires preparation of a Facility Plan for wastewater facilities to qualify for water pollution control funding grants administered by the EPA. This plan identified deficiencies and developed alternatives for overcoming the deficiencies of the publicly-owned gravity sewers, pumping stations and force mains, which make up the Back River conveyance system. During the preparation of this report, interviews with Baltimore City Water and Wastewater Maintenance Division personnel indicated that flooding along Gwynn’s Run during severe tropical storms had caused extensive damage to sanitary facilities along the stream. Many defects were identified in manholes and pipes along Gwynn’s Falls and Gwynn’s Run. Also, due to the concentration of restaurants in the eastern downstream portions of the Low Level Sewershed, frequent clogging from grease buildups occur in the collection system and smaller interceptor pipes.

The 1992 Facility Plan indicates that violations of fecal coliform, dissolved oxygen, and pH standards in streams have been reported and were usually associated with direct sewer discharges, overflows, and exfiltration from the sanitary sewerage system, violations of NPDES permits, septic tank failures, and stormwater runoff. The Industrial Discharge Information System (IDIS) identified 127 active direct and indirect NPDES dischargers to surface water as of May 1980. The majority of the NPDES dischargers are located in the vicinity of the highly industrialized Baltimore Harbor area. In addition to NPDES dischargers, 129 locations were identified where discharges of untreated wastewater from the conveyance or collection systems occur from time to time. These included direct discharges, emergency reliefs, overflows, and maintenance reliefs.

In September 2002, the City of Baltimore Department of Public Works entered into a Consent Decree with the Environmental Protection Agency (EPA), the Department of Justice (DOJ), and Maryland Department of Environment (MDE) to address sanitary and combined sewer overflows associated with the sewer collection system across the entire City. Estimated as a \$900M program, the Consent Decree defines multiple remedial measures and initiatives to be undertaken by the City prior to the 2016 completion date. It also establishes interim milestone deadlines for large-scale measures such as construction projects and comprehensive investigative studies. The remedial measures and initiatives implemented by the City will ultimately contribute to better protection of the Baltimore Harbor, Maryland streams, the Chesapeake Bay, and the property of the citizens of Baltimore.

Significant progress has been made thus far. Since 2002, the City has spent over \$330M on construction projects required to eliminate sanitary sewer overflows located throughout the City. Completion of 37 of 39 construction projects has enabled the City to eliminate 58 overflow structures. By doing so, raw sewage is prevented from discharging into streams at these locations during wet weather. The City has also embarked on a comprehensive investigation of the entire collection system. Multiple consultants are under contract to investigate manholes and pipes within the City limits, perform engineering evaluations including hydraulic modeling, and

ultimately develop recommendations for system improvements, which once approved by the regulators, will be implemented by 2016.

1.3 Purpose of Sewershed Study

The Low Level Sewershed study assists in Baltimore's compliance with the Clean Water Act and Title 9, Subtitle 3 of the Environment Article, Annotated Code of Maryland and the regulations promulgated thereunder, and all terms and conditions of the Back River and the Patapsco NPDES Permits. SSOs and dry weather overflows have been evaluated for elimination in the Low Level Sewershed collection system through development and implementation of the measures set forth in Paragraphs 8 through 15 of the CD. Illegal stormwater or sewer connections are identified for elimination. Potential rainfall-dependent infiltration/inflow (RDI/I) sources from privately owned customer service laterals have been identified through an extensive smoke and dyed water testing program. Baltimore's GIS has been updated to be accurate, fully functional, and capable of displaying the information described in Paragraph 14.B.i through iv of the CD.

1.4 Description of the Sewershed

The Low Level sewershed is located in the downtown central business district and adjacent to the harbor area of the City of Baltimore (see Figure 1.4.1). The sewershed includes dense residential areas, heavily industrial areas and the downtown commercial districts. The mixture of diverse land uses and the presence of significant industrial areas make Low Level unique compared to the City's other sewersheds. The Low Level sewershed includes 13.3 square miles of contributing drainage area and two primary Interceptors (East and West) that convey flow to the Eastern Avenue Pumping Station (EAPS).

The sanitary sewer collection system in Low Level contains a gravity sewer network of approximately 265 miles of pipe ranging in size from 6- to 84-inches in diameter. Approximately 90 miles of that total length are pipes with diameters greater than 10-inches that were incorporated into the hydraulic model. Other aspects of the Low Level sewershed sanitary sewer collection system include approximately 8,600 manholes, junction chambers and siphon chambers; 39,000 LF of force main and pressure sewer; 6 sewer siphons; two primary Interceptors (East and West); and three major pumping stations, the Eastern Avenue Pumping Station (120 mgd capacity), the Locust Point Pumping Station (1.8 mgd capacity) and the McComas Street Pumping Station (0.7 mgd capacity).

The Low Level Sewershed is one of eight individual sewersheds located within the City (Figure 1.4.1). The Low Level sewershed has a population of approximately 375,000 and is highly urbanized. The EAPS serves as the terminus of the collection system with two primary interceptors feeding it - East and West Interceptors. The EAPS is currently being renovated to add SCADA logic control containing revised operational set points to allow for automated pump control. Leading up to and throughout this project, the EAPS has operated completely under manual pump control. All sewage pumped by the EAPS is conveyed into the main Outfall Interceptor via a 60-inch diameter force main to a 99-inch diameter gravity outfall and then to the City's Back River WWTP.



Figure 1.4.1 Location of Sewershed in the City

The Gwynn's Falls is one of Baltimore's three stream valleys. It enters in the northeast corner of Low Level and traverses through the western portion of the sewershed before discharging to the Inner Harbor. The section of Gwynn's Falls in Low Level is prone to flooding in certain areas particularly where it is paralleled by the West Low Level Interceptor. This area figures prominently in eliminating overflows throughout the alternatives analysis.

The **East Low Level Interceptor**, mostly constructed from 1910 through the 1920's, conveys wastewater generated in the eastern portion of the Low level Sewershed to the Eastern Avenue Pumping Station. The interceptor is approximately 17,900 feet long and parallels the north shore of the Northwest Branch of the Patapsco River from the Eastern Avenue Pumping Station

to Clinton Street. East of Clinton Street, the interceptor generally follows the Amtrak Railroad in a northeasterly direction. Seventeen interceptors are tributary to the East Low Level Interceptor. The drainage area for the East Low Level Interceptor consists primarily of residential land use. Industrial land use is generally confined to the eastern end of the area and to port-related industries along the shore line of the Northwest Branch. Commercial use is located primarily along the major thoroughfares, such as Eastern Avenue and Broadway. Patterson Park, located near the center of the East Low Level drainage area, is a heavily used open-space park. Although previous interviews with Baltimore City Wastewater Maintenance Division personnel did not identify major defects in the area feeding the East Low Level interceptor, the large concentration of restaurants in the downstream portions of the area contribute to frequent clogging from grease buildup in the collection system and smaller interceptor pipes.

The **West Low Level Interceptor**, mostly constructed between 1910 and 1920, conveys wastewater generated in the western portion of the Low Level Sewershed to the Eastern Avenue Pumping Station. The interceptor is approximately 28,800 feet long and generally follows the Maidens Choice and the Gwynn's Falls stream valleys to Russell Street, where it then proceeds northwesterly to the Inner Harbor and downtown areas of the City. Twenty one interceptors, plus the Locust Point and McComas Street pumping stations are tributary to the West Low Level Interceptor. The tributary areas are generally comprised of both residential and industrial land uses. Notably, the area between Monroe Street and the Inner Harbor is largely industrial, including shipyards, docking facilities, other port-related industries, Camden Industrial Park, and Camden Railroad Yards. The central business district serves residential and industrial areas as well as the University of Maryland Baltimore Campus and the University Hospital. East of the Jones Falls Expressway and East Falls Avenue, the land use is residential and industrial, and also includes the City Jail and the Maryland State Penitentiary. Previous interviews with Baltimore City Wastewater Maintenance Division personnel indicate that flooding, pipeline silting, and manhole defects are recurring problems in the area along Gwynn's Falls, Maidens Choice, and Gwynn's Run streams and their tributaries.

Map 1.5.1 shows the major sewers and pump stations in the Low Level sewershed.

1.5 Collection System Components and Attributes

The components of the collection system included in the sewershed evaluation consist of gravity sewers having a diameter of 8-inches or greater; pumping stations, force mains and pressure sewers; and all appurtenances, including manholes, junction chambers, siphons, etc. In addition to the major interceptors described above, the Low Level Sewershed includes major pumping station and force main system components as described below.

The Eastern Avenue Pumping Station is located at the intersection of Eastern Avenue and South President Street and was originally constructed in 1912. The pumping station houses five constant speed pumps with a sixth emergency pump for discharge directly to the Inner Harbor in an extreme flooding event. This emergency bypass pump has not been used for many years. The EAPS is currently undergoing a SCADA upgrade to provide better control of the pumps based on varying levels in the pumping station wet well. The maximum capacity of the pumping station is approximately 120 MGD. Only one pump is typically needed during dry weather flows.

The Locust Point Pumping Station is located near the intersection of Port Road and Crane Road and was originally constructed in 1977. The capacity of the pumping station is 1.8 MGD. The Locust Point Pumping Station discharges into a 10-inch force main before conveying flows into a 10-inch gravity sewer. Flows from the Locust Point Pumping Station are eventually conveyed to the Eastern Avenue Pumping Station via the West Low Level Interceptor.

The McComas Street Pumping Station is located at the intersection of Key Highway and I-95 and was originally constructed in 1980. The capacity of the pumping station is 0.7 MGD. The McComas Street Pumping Station discharges into a 6-inch force main before conveying flows into an 18-inch gravity sewer. Flows from the McComas Street Pumping Station are eventually conveyed to the Eastern Avenue Pumping Station via the West Low Level Interceptor.